

Mosquito Borne Disease Transmission and Control

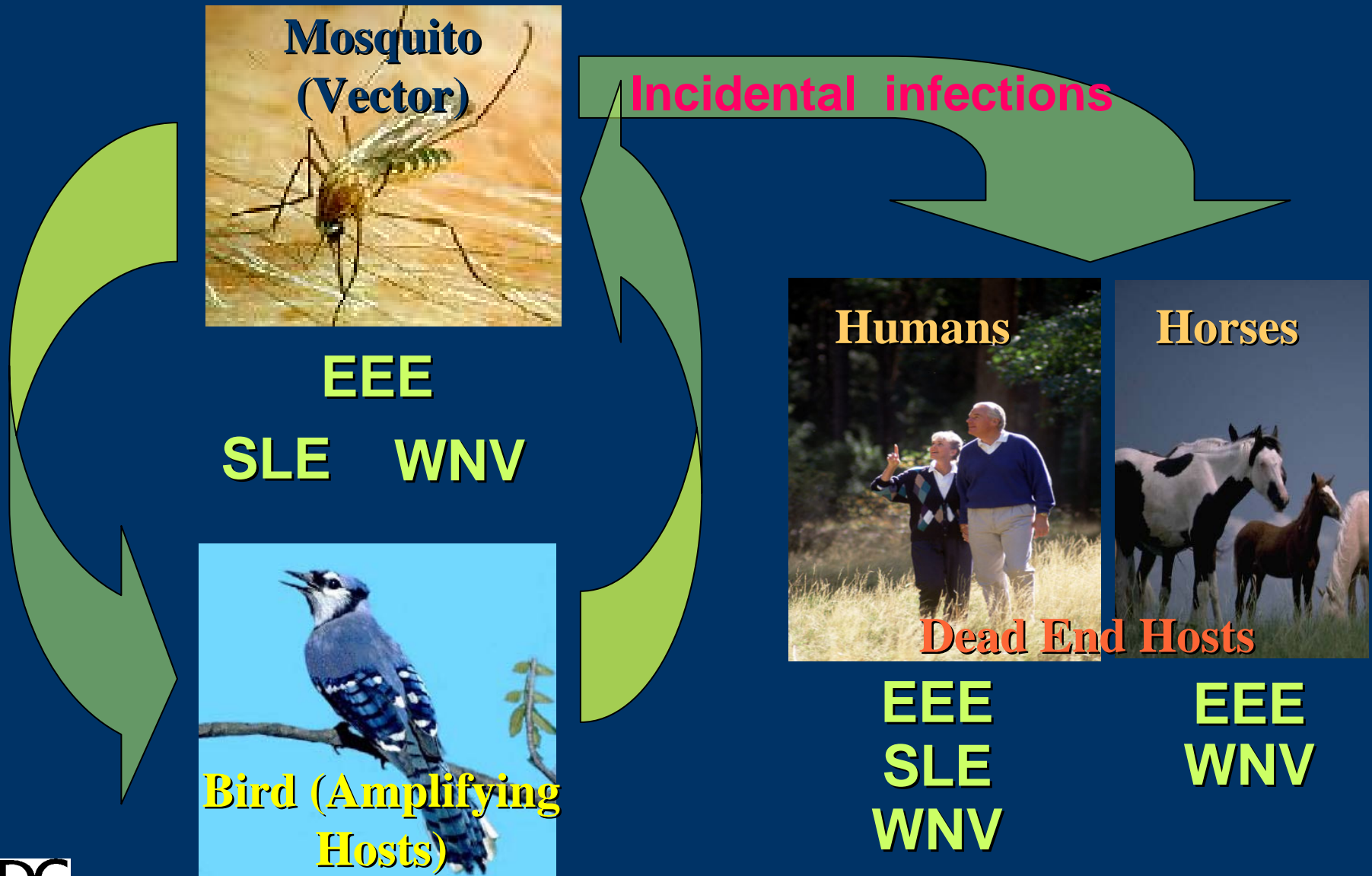
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Mosquito-borne Arboviral Diseases in Virginia.

- 1. Eastern equine encephalitis (EEE):** – Uncommon (5 human cases in past 30 years); coastal plain & low piedmont area.
- 2. St. Louis encephalitis (SLE):** - Somewhat uncommon (12 human cases in past 30 years); urbanized areas of piedmont region.
- 3. West Nile virus (WNV):** - New, common (60 human cases & 4 deaths in last 3 years); all over state
- 4. La Crosse encephalitis (LAC):** - Somewhat common, under-reported (20 human cases reported in past 30 years); southwest and western mountain zone of Virginia .

Transmission Cycle of EEE, SLE and WNV.



American Mosquito Species Associated with Eastern equine encephalitis (EEE)

Primary Vector,
Possible Bridge Vector

Culiseta melanura *

**Potential Bridge
Vectors**

Aedes albopictus *

Aedes vexans *

Ochlerotatus canadensis *

Ochlerotatus sollicitans *

Coquillettidia perturbans *

Culex salinarius *

Culex nigrihalpus

* Mosquito species found in Virginia

American Mosquito Species Associated with St. Louis encephalitis (SLE)

**Primary Vectors
& Potential
Bridge Vectors**




- Culex pipiens* *
- Culex quinquefasciatus*
- Culex restuans* *
- Culex nigrialpus*
- Culex salinarius* *
- Culex tarsalis*

* Mosquito species found in Virginia

Mosquito Species Associated with West Nile Virus (WNV)

Primary Vectors & Potential Bridge Vectors



Culex pipiens *
Culex quinquefasciatus
Culex restuans *
Culex nigrialsus
Culex tarsalis

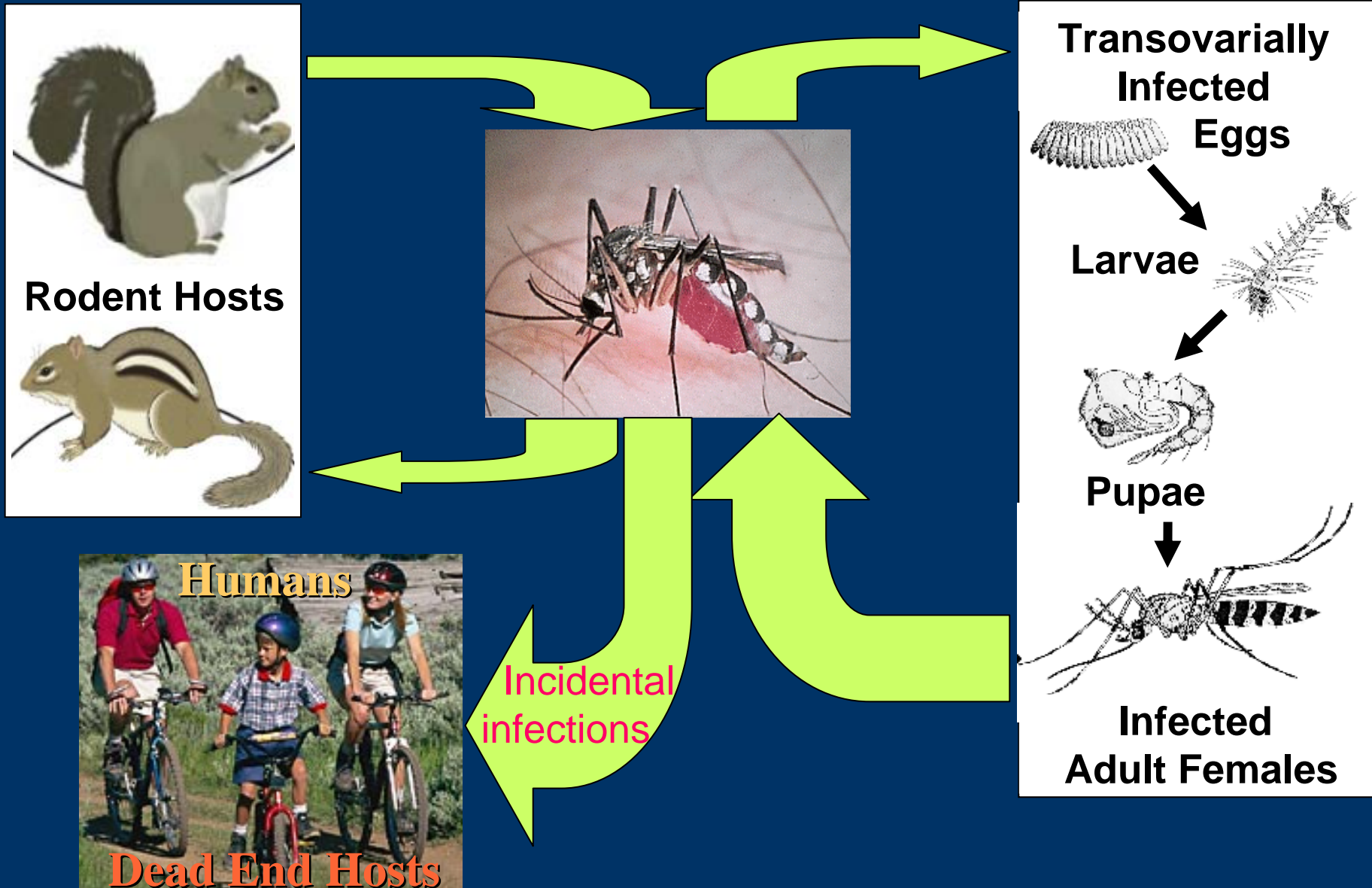
Potential Bridge Vectors



Culex erraticus *
Culex salinarius *
Aedes albopictus *
Aedes vexans *
Ochlerotatus japonicus *
Ochlerotatus triseriatus *

* Mosquito species found in Virginia

Transmission Cycles of La Crosse encephalitis (LAC)



American Mosquito Species Associated with La Crosse encephalitis (LAC)

**Primary Vector &
Bridge Vector**



Ochlerotatus triseriatus *

Bridge Vectors



Aedes albopictus *

Culiseta inornata *

Ochlerotatus canadensis *

Ochlerotatus communis

Ochlerotatus dorsalis

Ochlerotatus japonicus *

Ochlerotatus melanimon

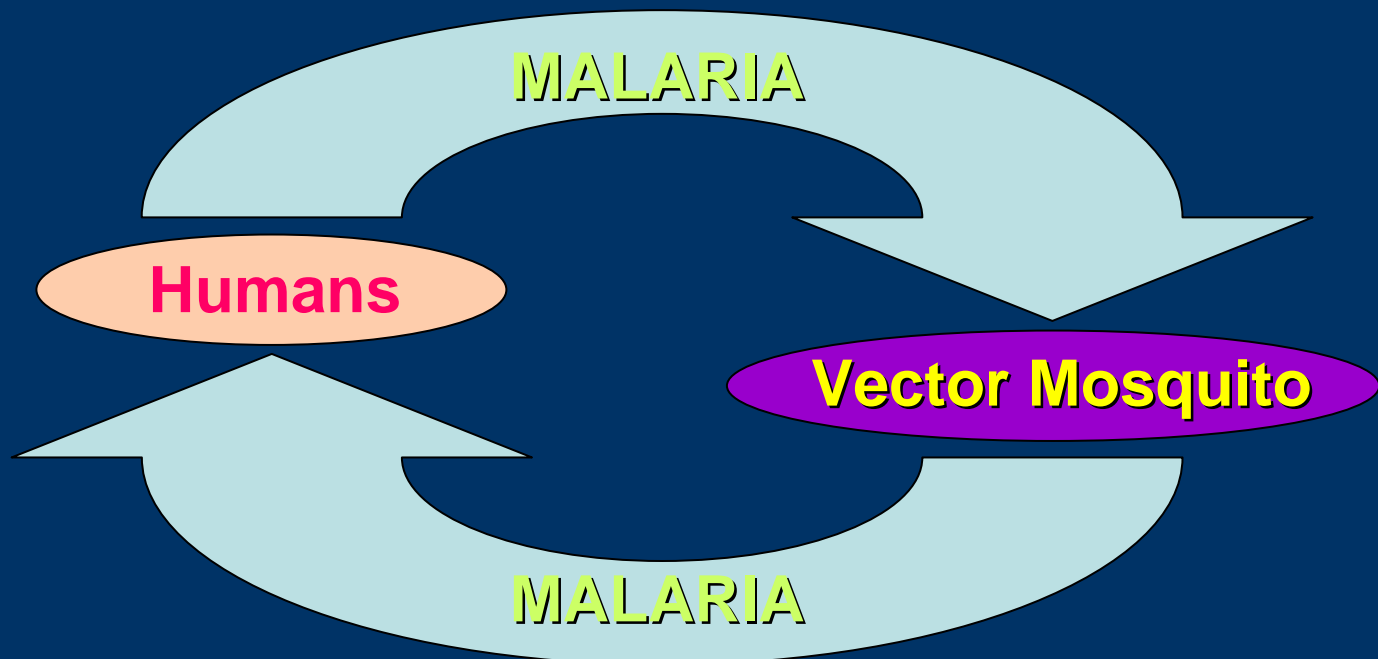
Ochlerotatus stimulans

* Mosquito species found in Virginia

Other Mosquito-borne Diseases seen in Virginia.

Malaria – Uncommon (four locally transmitted human cases in past 10 years; many imported cases each year).

Transmission Cycle of Malaria: Humans and Mosquitoes are the only significant disease reservoirs.



American Mosquito Species Associated with Malaria

Primary Vectors



Anopheles quadrimaculatus *

Anopheles punctipennis *

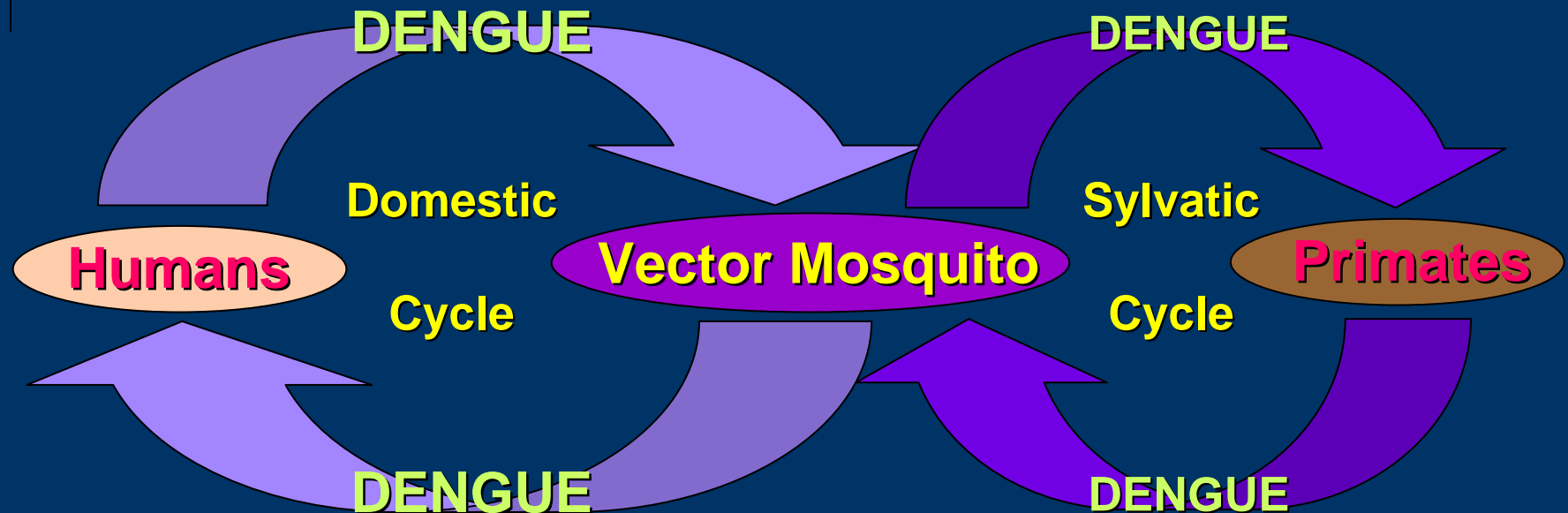
Anopheles freeborni

* Mosquito species found in Virginia

Dengue, a Mosquito-borne Arbovirus that Might Occur in Virginia.

Dengue has never occurred as a locally transmitted disease in Virginia. Local Transmission was seen in Hawaii as well as Texas, Florida and other Gulf Coast states over past 30 years; many imported cases seen in U.S. each year.

Transmission Cycles of Dengue: Humans and mosquitoes are the main reservoir species. The sylvatic cycle is only active in parts of Southeast Asia and Africa.



American Mosquito Species Associated with Dengue

Primary Vectors

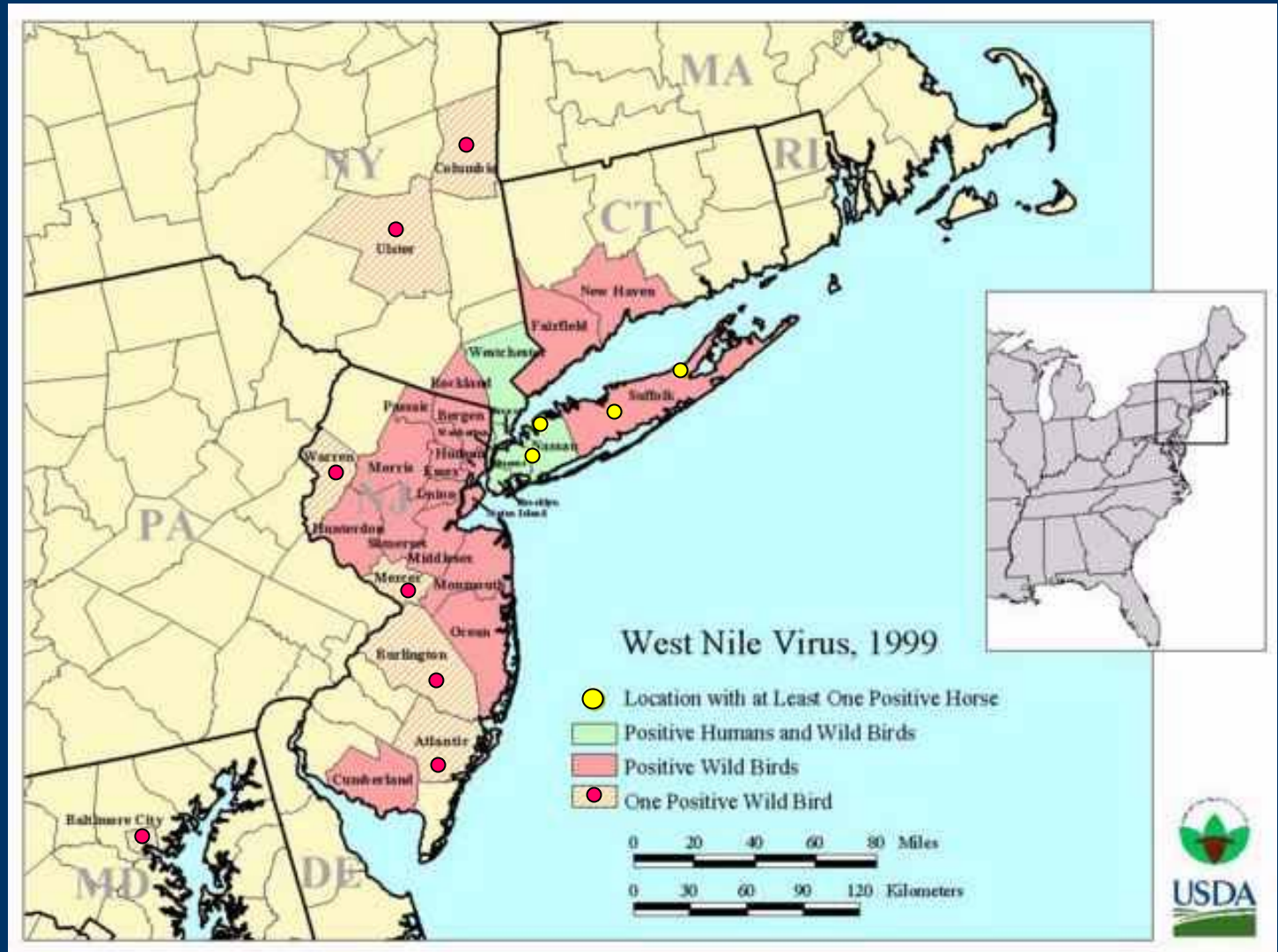


Aedes aegypti *

Aedes albopictus *

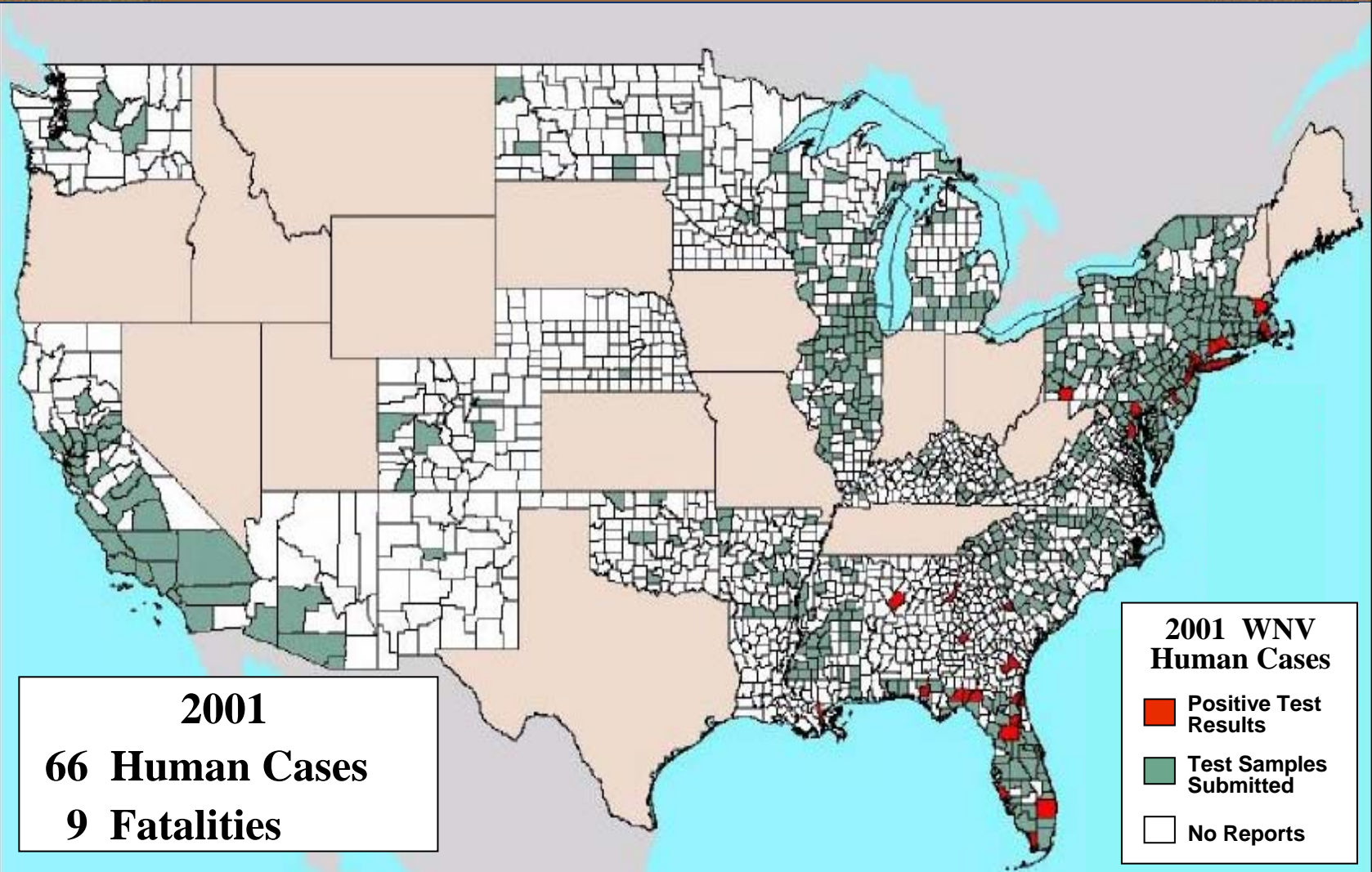
* Mosquito species found in Virginia

Discovery and spread of WNV in the United States in 1999

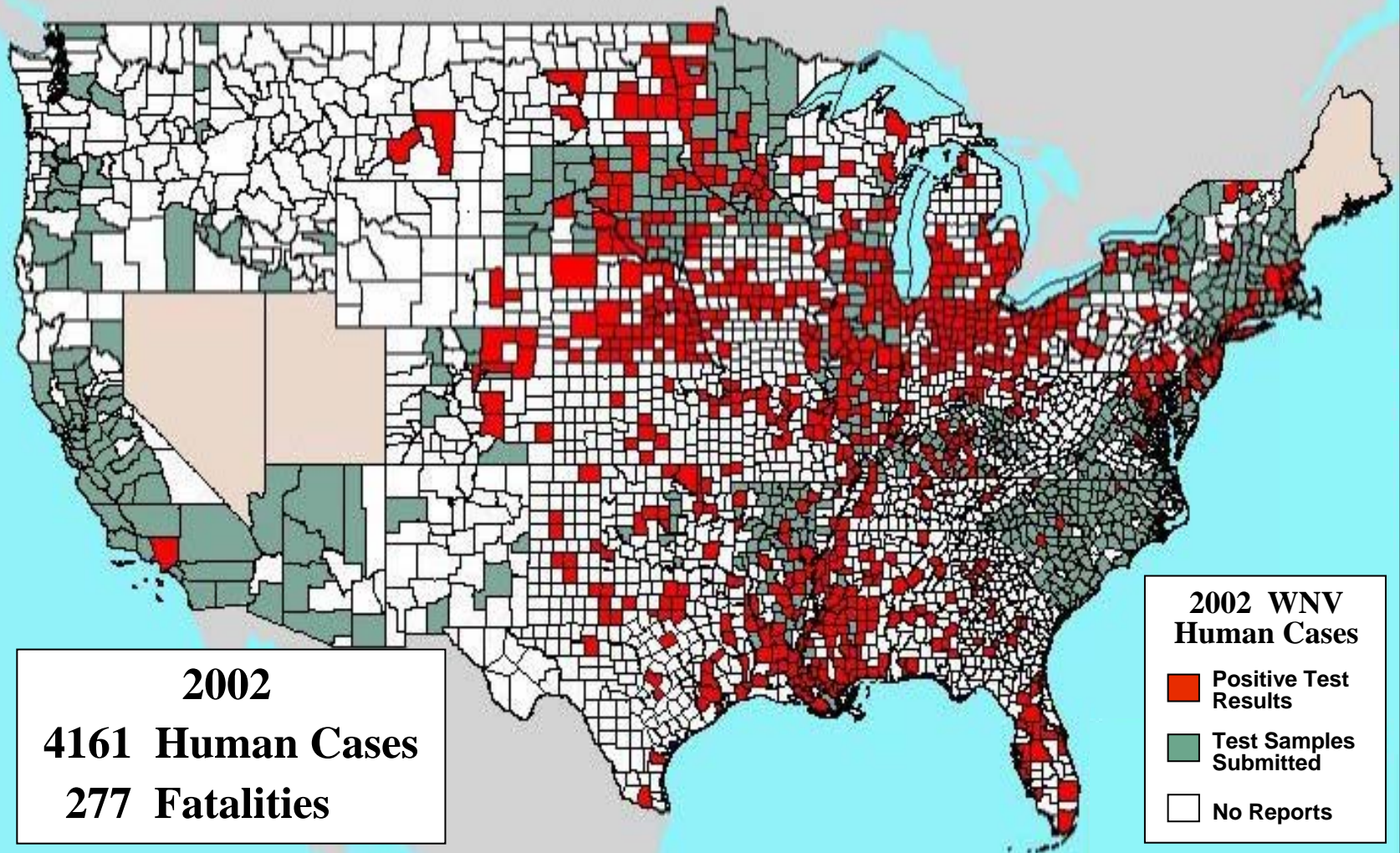


WNV hospitalized 62 persons in 1999 and seven patients died. WNV was detected in 194 birds and 25 horses (8 horses died).

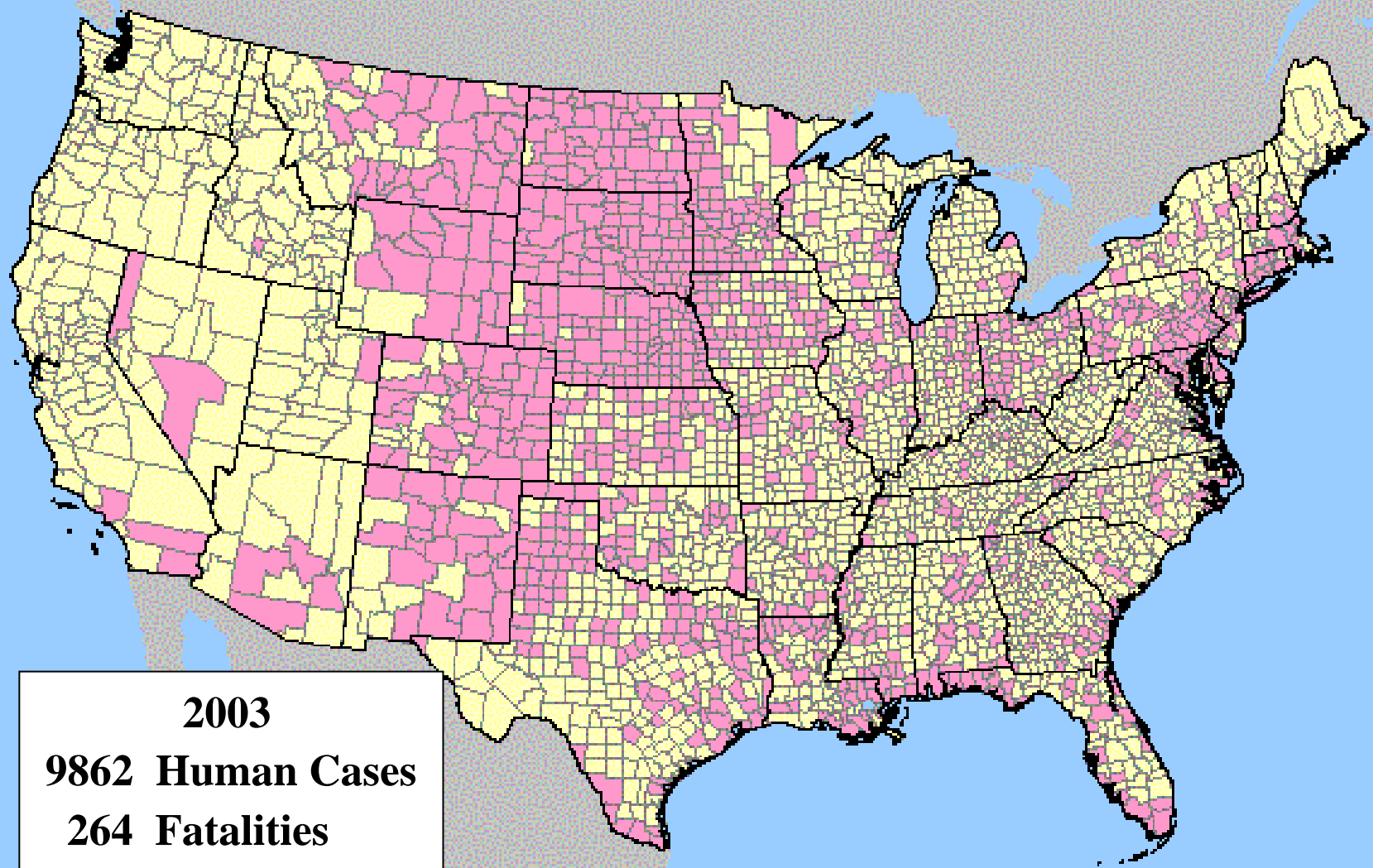
National Distribution of WNV Human Cases in 2001



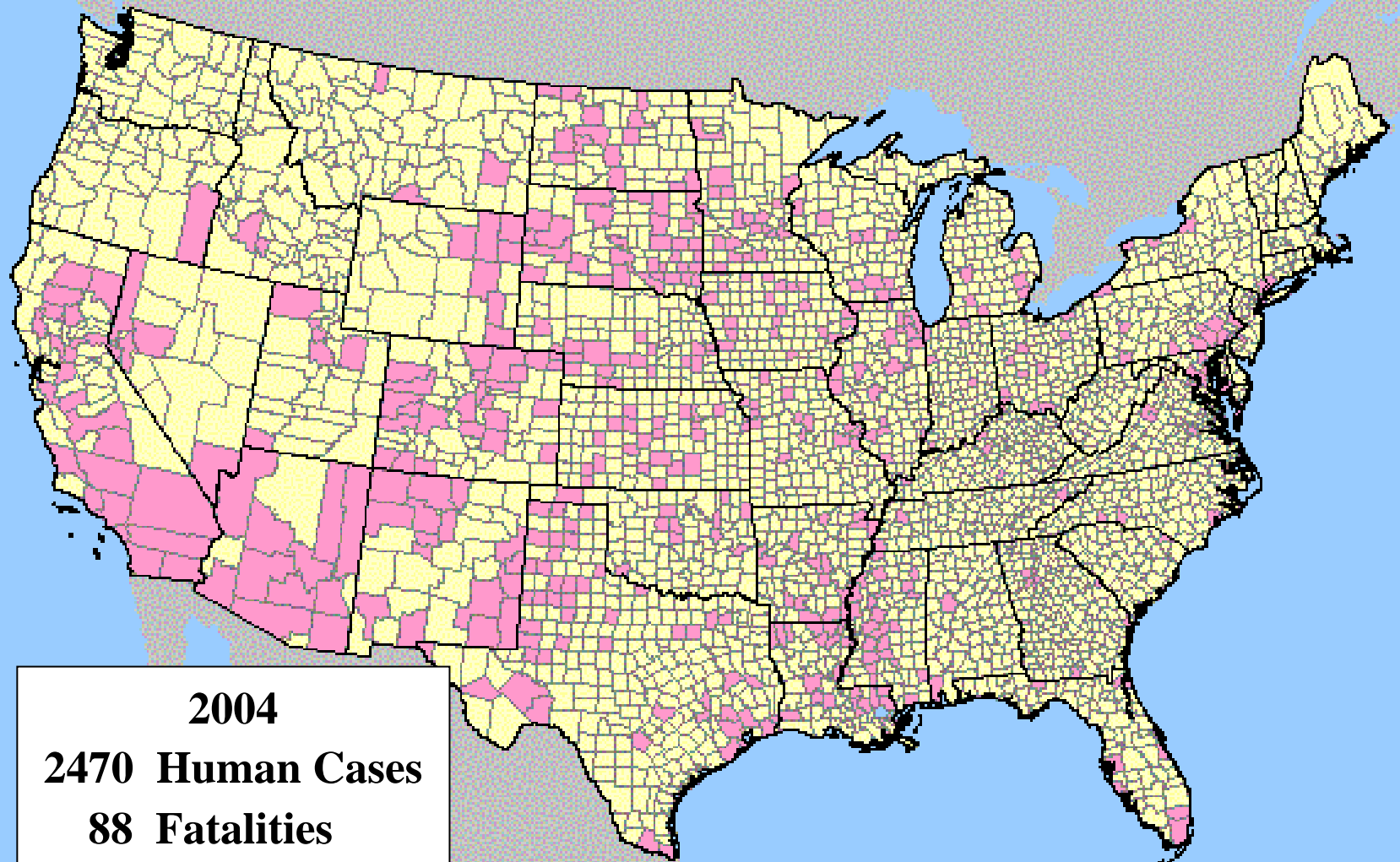
National Distribution of WNV Human Cases in 2002



National Distribution of WNV Human Cases in 2003



National Distribution of WNV Human Cases in 2004



National WNV Activity by Year

YEAR	1999	2000	2001	2002	2003	2004
Human Cases	62	20	66	4,161	9,862	2,470
WNND Cases					2,587	897
Median Age (All Cases)	77	62	68	55	47	52
Case age range in 2004 was (1 month - 99 yrs.)						
Human Deaths	7	2	9	277	264	88
Mortality %	11%	10%	14%	7%	3%	4%
% of WNND Cases					10.2%	9.8%
Median Age (Mortality)	68	77	70	77	77	73
Mortality age range in 2004 was (43 - 95 yrs.)						

Commonly Used Methods of Mosquito Control for Disease Prevention

Commonly Used Mosquito Control Tactics:

- 1. Larval and adult mosquito surveillance**
- 2. Larval mosquito control (larvicide applications)**
- 3. Habitat management (drainage control and breeding habitat elimination/modification)**
- 4. Public education**
- 5. Adult mosquito control (ULV aerosol applications / fogging , barrier treatments)**
- 6. Biological mosquito control (mosquito fish)**

Larval Mosquito Control: Larvicide applications are the most widely used and efficient mosquito control tactic.

Larvicides are applied to aquatic breeding habitats to kill immature mosquitoes before they can become flying, blood-feeding, reproductive adults.



Larval Mosquito Control: Several of the most important WNV and SLE vectors commonly breed in puddles that occur in underground storm-sewer systems (e.g., catch basins and man-holes).

Larvicide applications to underground bodies of water can be difficult because they are often inaccessible.

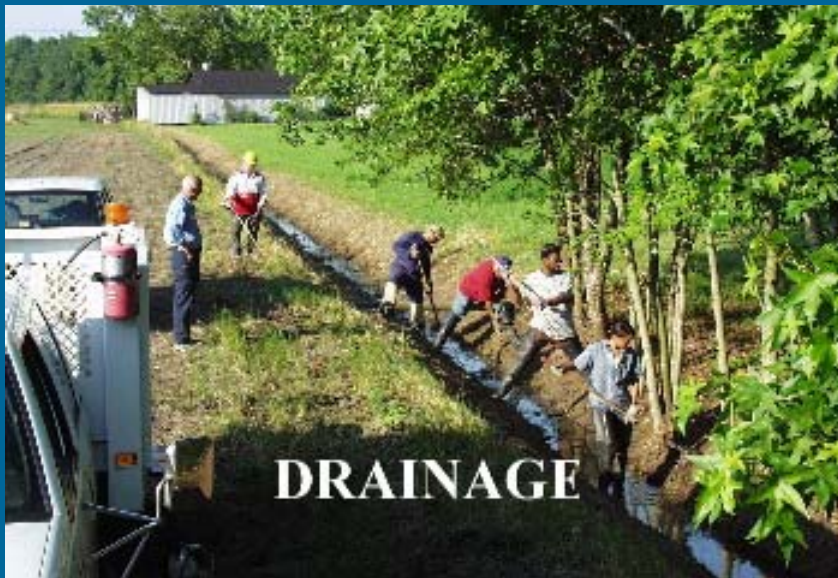
Most WNV and SLE prevention programs have extensive larviciding programs for their storm-sewer systems.



Habitat Management: Drainage control and breeding habitat elimination/modification are widely applied mosquito control tactics.

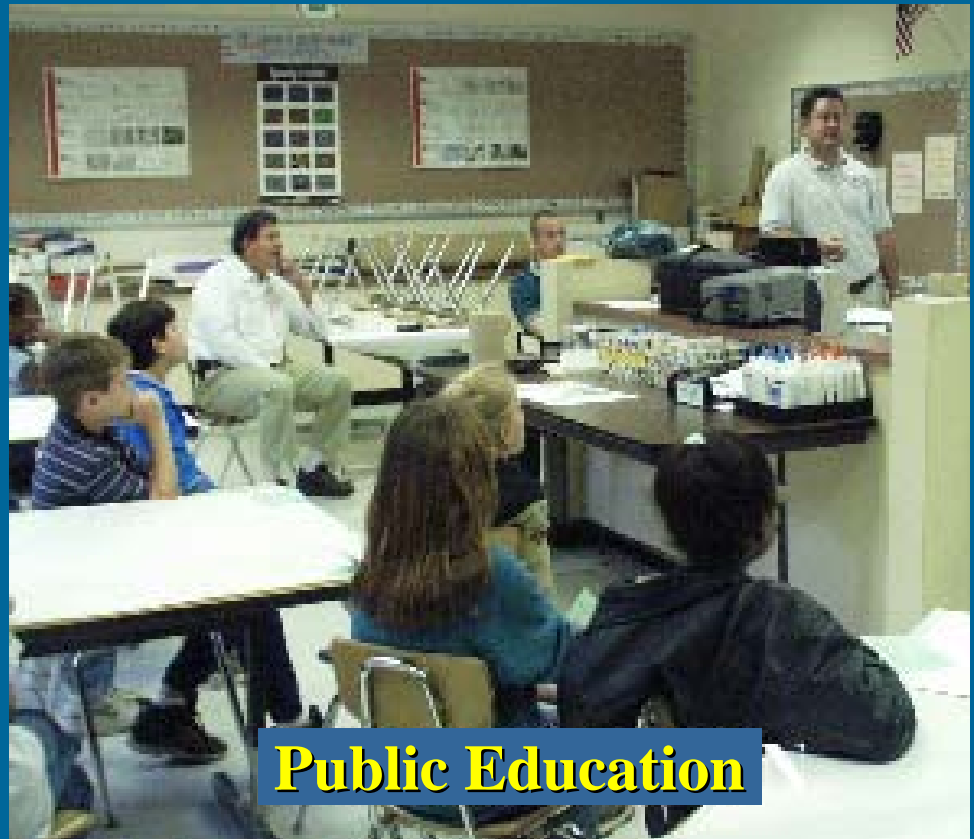
Ditches are made to flow, puddles are filled or drained, and artificial containers of water are removed or drained.

Shallow, temporary ponds can be deepened and/or made permanent to discourage colonization by mosquitoes and encourage the establishment of predatory species.



Public Education: A large portion of the WNV, SLE and LAC vector mosquito population originates from artificial breeding habitats (water containers) found around homes on private property.

Public education tells citizens how to eliminate or treat mosquito breeding habitats on their own property and how to protect themselves against mosquito bites.



Public Education

Adult Mosquito Control:
Fogging and ULV aerosol
applications are used to treat
large areas (volumes of air)
to kill flying adult
mosquitoes.

Aerosols have little impact on
sheltered or resting adult
mosquitoes.



Aerial Applications



Ground-based Applications

ULV aerosol applications
are most commonly used
to reduce large mosquito
populations that have
escaped larval control,
and/or when the potential
for disease transmission is
very high.

Adult Mosquito Control: Some WNV and SLE control programs make ULV Aerosol or thermal fog applications to the insides of urban storm sewer systems to kill the adult *Culex* mosquito species that breed in, and take refuge in such underground habitats.



Storm Sewer Fogging

Biological Mosquito Control: Mosquito fish (*Gambusia* species) are minnow-sized fish that function well in the shallow aquatic habitats that larval mosquitoes prefer.

Many county and municipal mosquito control programs breed mosquito fish in hatcheries and release them in appropriate habitats, or hand them out to citizens for control of immature Mosquitoes in aquatic habitats.

Mosquito fish are particularly useful for controlling mosquito species that would breed in back yard ornamental ponds or abandoned swimming pools.



The End

